Biased voter model: How persuasive a small group can be?

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We study the voter model dynamics in the presence of confidence and bias. We assume two types of voters. Unbiased voters (UV) whose confidence is indifferent to the state of the voter and biased voters (BV) whose confidence is biased towards a common fixed preferred state. We study the problem analytically on the complete graph using mean field theory and on an Erdos-Renyi (ER) random network topology using the pair approximation, where we assume that the network topology is independent of the type of voters. We verify our analytical results through numerical simulations. We find that for the case of a random initial setup, and for sufficiently large number of voters N, the time to consensus increases proportionally to log(N)/γv, with γ the fraction of biased voters and v the bias of the voters. Finally, we study this model on a biased-dependent topology. We examine two distinct, global average-degree preserving strategies (model I (MI) and model II (MII) in Fig.1(b)) to obtain such biased-dependent random topologies starting from the biased-independent random topology case as the initial setup. In M1 we find that if we simply vary μ_{BU}, the average number of links among the two types of voters (BV-UV), no significant effect was observed (blue line Fig.1). Instead, in MII, increasing μ_{BB}, the average number of links among only biased voters (BV-BV) at the expense of μ_{UU} that of only unbiased voters (UV-UV), while keeping μ_{BU} constant, resulted in a significant decrease in the average time to consensus in the group (red line Fig.1). Hence, persuasiveness of the biased group depends on how well its members are connected among each other, compared to how well the members of the unbiased group are connected among each other.
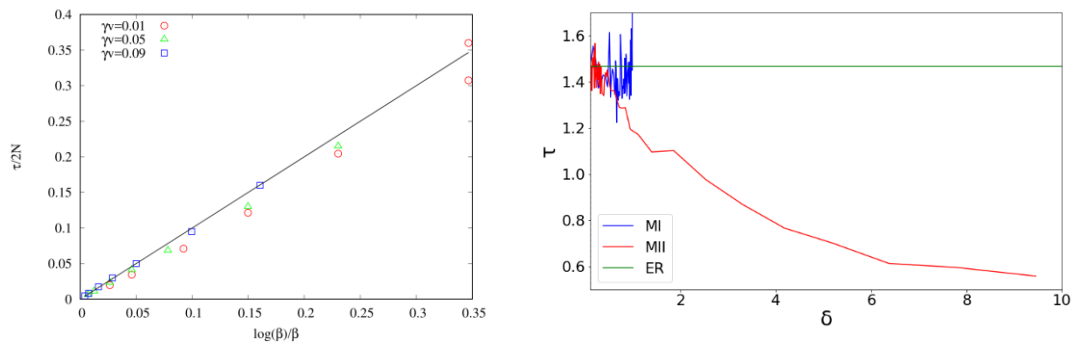

Figure 1: (a) we see the logarithmic scaling of the consensus time as a function of the effective bias $\beta = \gamma v N$ for the complete graph topology (analytical vs numerical results). (b) we plot the consensus time as a function of $\delta = \mu_{BB}/\mu_{UU}$ with μ_{XX} the average degree among only type X voters, for the case of a biased-dependent ER topologies (blue and red lines) vs the biased-independent ER topology case (green line).

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